PATENT SPECIFICATION

557,823

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Complete Specification Accepted: Dec. 7, 1943.

COMPLETE SPECIFICATION.

Improvements in and relating to Cementing Plugs for Oil Wells and the like

We, JAMES CUTHILL, a British Subject, of Glencoin, 129, Bramhall Lane South, Bramhall, Cheshire, and THE OIL WELL ENGINEERING COMPANY, LIMITED, a British Company, of Cheadle Heath, Stockport, Cheshire, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to cementing plugs for use in connection with the cementing of the space between the steel lining of a bore hole and the surface of the earth strata of the hole.

In the drilling of wells or bore holes for the production, for example of oil, water or brine, it is usual to line the walls of the hole with steel casing for the purpose of supporting the walls and also to prevent ingress of water from the upper strata, which may be undesirable. The steel casing in lengths which are jointed by the usual screwed couplings or by welding is inserted into the bore hole, and for ease of insertion, the exterior diameter of the casing is somewhat less than the diameter of the bore hole.

The lower end of the casing is usually provided with a heavy steel shoe of tubular form. The shoe is provided with an internal plug of cast iron, aluminium, concrete, artificial resin, or other material capable of being drilled. Within this plug a non-return valve is located for preventing the flow of liquid from the hole upwardly into the casing, while permitting liquid being pumped down through the casing beneath the shoe and then upwardly through the annular space between the casing and bore hole.

The casing is inserted in the bore hole until the shoe is a short distance above the bottom of the hole and then it is usual to pump or circulate water or mud fluid from the surface through the casing and non-return valve. This water or mud fluid will then pass upwardly through the annular space between the casing and surface of the bore hole until it reaches ground level. This circulation of liquid is for the purpose of washing away any obstructions, such as mud or clay from the annular space, the presence of which would be objectionable to the subsequent cementing operation.

After circulating the water or mud fluid, a plug is inserted inside the casing at the surface, the top fittings of the casing closed and liquid cement pumped down inside the casing on top of the plug, causing the plug to travel down the casing.

When a sufficient quantity of liquid cement has been pumped into the casing, a second or top plug is inserted above the liquid cement and, after the top fittings having again been fixed in position, mud fluid is pumped into the casing above the second plug, forcing the whole column of liquid cement and mud fluid downwards until the first plug abuts against the shoe plug at the bottom of the casing. Continued pumping causes the second or top plug to travel downwardly forcing the liquid cement through passages in the bottom plug, and thence past the non-return valve to the annular space around the casing until the whole quantity of liquid cement has been injected in the bore hole and the top plug comes into contact with the bottom plug, the completion of the process being indicated by an increase of the pumping pressure at the surface.

The well is then left for a sufficient time to allow the liquid cement to set and form an impermeable seal and support for the earth strata around the outside of the steel casing.

The cement having set, the various plugs, that is the top plug, the bottom plug and the shoe plug with the non-return valve, which are all constructed of a drillable material, are drilled out, the drilling being continued through the cement below the shoe.

It is an object of the present invention to provide an improved form of cementing plug which may readily be constructed and which is particularly suitable to the after-cementing drilling operation.

It is important that the operator should know when the cementing plugs have been penetrated while being drilled after the cementing operation.

It is known in connection with bore hole

cementing equipment to have to drill up a concrete plug and in practice such concrete has been coloured by the inclusion of a suitable colouring material. When such a coloured plug is drilled up the cuttings are mixed with the mud fluid being circulated.

It is a further object of the invention to provide improved colour indicating means incorporated in the plug.

The cementing plug according to the invention is formed by moulding or casting it of concrete or similar cementitious material, and is provided with an annular flexible packing ring or diaphragm cast therein and adapted to engage the wall of the casing.

The plugs may have cast therein a bottle or other receptacle containing a dye or colouring matter adapted when released by drilling to stain the circulating mud fluid a distinctive colour.

In the accompanying drawings:—

Figure 1 is a sectional elevation through a bore hole showing the steel casing with the plugs in position for the cementing operation,

Figure 2 is an elevation of the bottom plug,

Figure 3 is a plan of the bottom plug,

Figure 4 is a sectional elevation,

Figure 5 is a sectional elevation of the top plug,

Figure 6 is a plan, and

Figure 7 is a sectional plan on line 7—7 of Figure 5.

In carrying the invention into effect according to one convenient mode by way of example, the bottom plug 6 which is cast or moulded in concrete or similar cementitious material, is of circular cross section, the lower part 6a being of a diameter conforming to the diameter of the steel casing 7 (Figure 1). The upper part 6b is of reduced diameter to provide an annular space between it and the casing. Near the upper end of the reduced part a flexible ring or diaphragm 8 of rubber or other suitable material is cast in the plug, being secured in position by soft metal nails, wooden pegs or the like 9. The diameter of the diaphragm is slightly in excess of the bore of the casing.

At the upper end the plug is provided with a dishing or recess 10 across which a tube 11 extends, the ends of the tube being cast in the plug. The tube 11 may be formed of any suitable drillable material such as compressed paper or artificial resin and provides means for lifting the plug.

Located at the junction of the parts 6a and 6b is a series of downwardly extending passages 12 which merge into an axial passage 13.

Located at a suitable position within the plug is a bottle or container 30 which contains a colouring material or dye which may be of solid powder, liquid or crystal form. The bottle is inserted during the casting of the plug.

The plug is cast in a suitable mould having provision for holding the diaphragm 8 and tube 11 in position.

The top plug 14 has its upper part 14a of a diameter permitting an easy sliding movement with the steel casing and may be cut away or necked at the central part 14b to save material and for lightness.

At the lower end the plug is provided with a cast-in diaphragm or ring 15 of rubber or other flexible material. The diaphragm is held in the groove by pins 16 similar to the diaphragm of the bottom plug.

The upper end 17 of the plug is of reduced diameter to accommodate a sealing ring 18 formed of rubber or other flexible material and having a flange 19 by which it is cast in the plug. Pins 20 are provided for holding the ring in position.

The upper end 17 is provided with a dishing or recess 21 across which the cast-in lifting tube 22 is located.

The top plug is of concrete or similar cementitious material, cast in a suitable mould in which positioning means are provided for the diaphragm 15, sealing ring 18, and the lifting tube 22. During casting a bottle or container 31 of dye or other colouring material is inserted at a suitable position.

In operation, the steel casing 7 having been placed in position and water or mud fluid circulated down the casing and upwardly through the annular space 24, the bottom plug 6 is inserted within the casing and liquid cement 25 pumped in above the plug, after which the top plug 14 is inserted. Mud fluid is now pumped into the casing about the top plug 14 causing the lower plug 6, cement 25 and top plug 14 to descend until the bottom plug 6 abuts against the concrete plug 26 of the shoe 27.

Continued pumping forces the top plug 14 downwardly whereby the cement is forced past the flexible diaphragm 8, through the passages 12 and 13 of the bottom plug, the passage 28 of the shoe plug, past the non-return valve 29 and into the annular space 24.

It will be appreciated that during this process the pressure liquid above the top plug is prevented from passing it by the flexible packing or sealing ring 18 which is of the nature of a U packing.

The diaphragm 15 operates to clean the inside of the casing scraping away any

deposit of cement thereon.

The flow of cement through the bottom plug passages continues until the top plug 14 engages the bottom plug.

During the subsequent drilling up of the top and bottom plugs, the dye bottles 31 and 30 will be ruptured to release the colouring matter which will stain the circulating mud fluid to indicate to the operator that the plug has been penetrated.

It will be appreciated that according to the strata being drilled through the mud in circulation will be of different colours and by the utilisation of staining dyes according to the invention suitable contrasting colours may be employed, operators being offered a selection of plugs with various colour staining properties.

Instead of casting the dye container in the plugs, the latter may be cast with a suitable recess or aperture into which the container is placed prior to the insertion of the plug in the casing, whereby suitably coloured dyes may be inserted as desired.

In some cases instead of the shoe plug and non-return valve being located at the bottom of the casing, they may set in a float collar located at a point intermediate the length of the casing.

The bottom plug may in some circumstances be dispensed with the liquid cement being allowed to be pumped down in contact with the water below it.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A cementing plug for use in the cementing of casings in bore holes, formed by moulding or casting in concrete or similar cementitious material, and having an annular flexible packing ring or diaphragm cast therein and adapted to engage the wall of the casing.

2. A cementing plug as claimed in claim 1, wherein the diaphragm is secured within the plug by pins passing through the diaphragm and embedded in the concrete or like material.

3. A bottom cementing plug as claimed in claim 1 or 2, having an upper reduced portion in which the diaphragm is located, and provided with radial passages merging into an axial passage extending through the lower portion.

4. A top cementing plug as claimed in claim 1 or 2, wherein the diaphragm is located in the lower part of the plug and wherein the upper part has a reduced portion forming a recess to accommodate a packing or sealing ring which is cast in the plug.

5. Cementing plugs as claimed in claim 1, 2, 3 or 4, wherein means are provided adapted on penetration of the plug by drilling, to stain the drilling mud a distinctive colour, said means comprising a bottle or container for a dye or colouring material of solid liquid powder or crystal form, said container with the dye being inserted into the plug during moulding or into a suitable recess moulded therein.

6. Cementing plugs substantially as described with reference to the accompanying drawings.

Dated this 18th day of June, 1942.

MARKS & CLERK.

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557,823 COMPLETE SPECIFICATION

SHEET 1

2 SHEETS

SHEET 2.

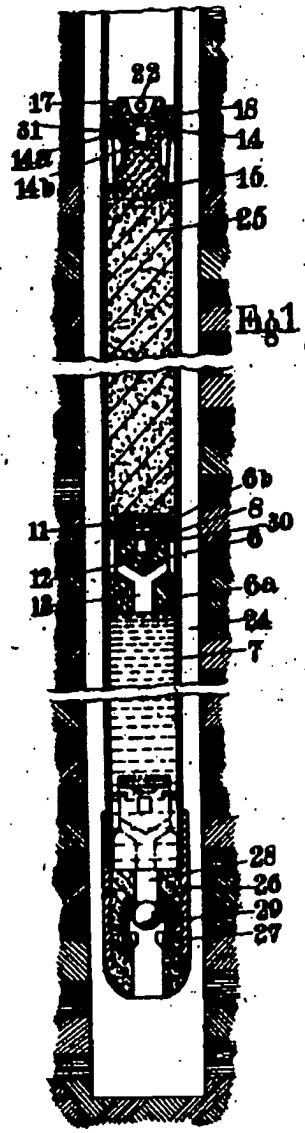

Fig.1

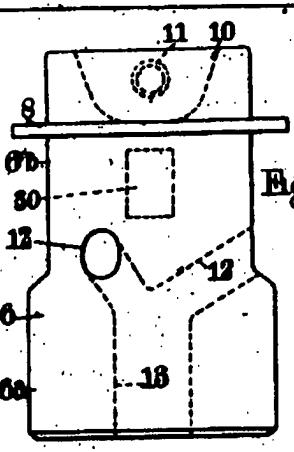

Fig.2.

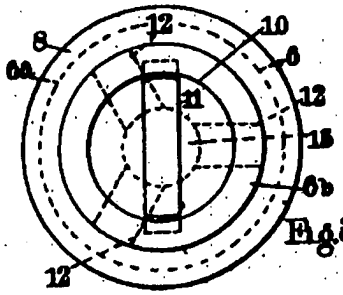

Fig.3.

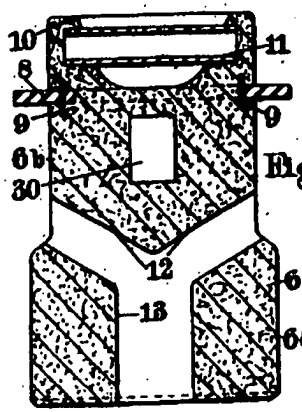

Fig.4.

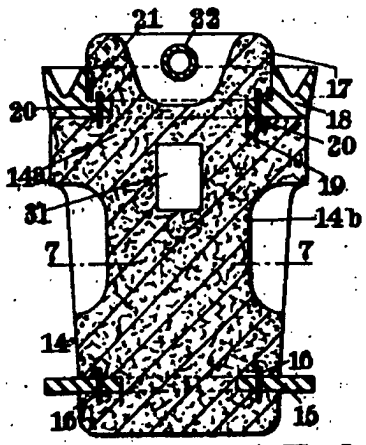

Fig.5.

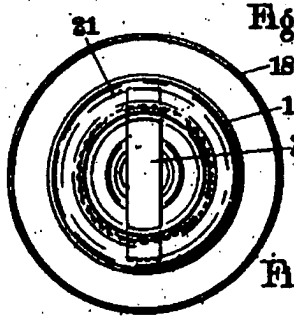

Fig.6.

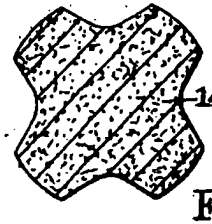

Fig.7.

Malby & Sons, Photo-Litho